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PATENT APPLICATION

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant(s): Makoto NAKAMURA
Title : CRANKSHAFT SUPPORTER

Serial No. : 10/601 779 Group: 3747
Confirmation No.: 9525
Filed : June 23, 2003 Examiner: Harris
International Application No.: -
International Filing Date : -
Atty. Docket No.: Saigoh C-301

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

FIRST CLASS MAILING CERTIFICATE

Sir:

I hereby certify that this correspondence is being deposited with the United States Postal Service under 37 CFR 1.8 as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on June 20, 2006.

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Correspondence: Letter Submitting Certified Translation of Foreign Priority Application dated June 20, 2006 including enclosures listed thereon

190.05/05

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LETTER SUBMITTING CERTIFIED TRANSLATION OF FOREIGN PRIORITY APPLICATION

Sir:

Applicant hereby submits the certified translation of the priority document. This translation was referenced in the Response dated May 23, 2006 and inadvertently omitted therefrom.

Respectfully submitted,

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Encl: Certified copy of English translation of Japanese Patent Application No. 2002-187755

110.0703

DECLARATION

I, MINASE, Toru, of Saigoh Patent Office, 2-8, Kanda-Ogawamachi, Chiyoda-ku, Tokyo, Japan, do hereby declare that I am conversant with the Japanese and English languages and am a competent translator thereof. I declare further that to the best of my knowledge and belief the following is a true and correct translation made by me of the document in respect to a Patent Application filled in Japan under the Number 2002-187755 on June 27, 2002.

DATED this 6 day of April, 2006

南瀬 透

MINASE, Toru

S-420

[Document Title] Specification

[Title of the Invention] CRANKSHAFT SUPPORTER

[Claims for the Patent]

1. A crankshaft supporter having

a support member which is attached to a cylinder block of an engine so as to support a crankshaft and which is formed of a matrix of aluminum alloy with a preform cast inside,

said support member comprising: a mounting surface in contact with a mounting surface in said cylinder block; a bolt hole corresponded to a bolt hole in said cylinder block and opened to said mounting surface of said support member; and a dowel hole in coaxial alignment with said bolt hole and opened to said mounting surface of said support member,

said crankshaft supporter comprising:

a penetrated section in said preform which a through hole defining said bolt hole is formed therein;

and a recess section which is formed of said matrix and is positioned between said mounting surface of said support member and an opposing surface of said penetrated section that faces said mounting surface so as to shape said dowel hole.

2. The crankshaft supporter as defined in claim 1,

wherein said support member has a plurality of bolt holes therein,

said dowel hole is defined to open to said mounting surface of said support member in coaxially alignment with at least one said bolt hole,

and a recess section formed of said matrix to shape said dowel hole is defined between said mounting surface of said support member, where said dowel hole is formed, and an opposing surface of said penetrated section that facing said mounting surface of said support member.

3. The crankshaft supporter as defined in claim 1, wherein said preform has said opposing surface displaced in a depth direction of said dowel hole so that a recess section formed of said matrix to shape said dowel hole is defined between said mounting surface

of said support member, where said dowel hole is formed, and said opposing surface of said penetrated section that facing said mounting surface of said support member.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

This invention relates to crankshaft supporters, and more particularly to a crankshaft supporter which permits an easier cutting process to a knock-pin (dowel) hole so as to reduce wear of blades of cutting tools.

[0002]

[Related Art]

In engines mounted on vehicles, a crankshaft is supported by a crankshaft supporter in a lower part of a cylinder block. The crankshaft supporter is shown in Figures 11 and 12. Figure 11 shows an engine 102, a cylinder block 104, a crankshaft 106, and a crankshaft supporter 108. The crankshaft supporter 108 includes, in the cylinder block 104, a bearing section 110, a mounting sections 112 adjacent sides of the bearing 110, and outer walls 114 outward of the mounting section 112.

[0003]

The bearing section 110 in the cylinder block includes a bearing metal 116. The mounting sections 112 in the cylinder block have bolt screw holes 120 which are opened to a mounting surface 118 of the cylinder block. As shown in Figure 12, the mounting surface 118 defines therein a knock-pin (dowel) hole 122 that opens to the mounting surface 118 and in a coaxial alignment with the bolt screw holes 120.

[0004]

The crankshaft supporter 108 is mounted to the cylinder block 104 of the engine 102 so as to support the crankshaft 106, and includes a lower crankcase 128 that is formed of aluminum alloy as a matrix 124 and that has a preform (core material) 126 cast (embedded) therein.

[0005]

The lower crankcase 128 is provided with a bearing section 130 opposing to the bearing 110 section in the cylinder block, mounting

sections 132 located adjacent both sides of the bearing section 130 and attached to the mounting sections 112 in the cylinder block, and outer walls 134 outward of the mounting sections 132 to correspond to the outer walls 114 in the cylinder block.

[0006]

The bearing section 130 in the lower crankcase is equipped with a bearing metal 136 corresponding to the bearing metal 116 in the cylinder block. The mounting sections 132 in the lower crankcase include bolt holes 140 which correspond to the bolt hole 120 and which are opened to a mounting surface 138 of the lower crankcase. A dowel hole 142 opened to the mounting surface 138 is defined in coaxial alignment with the bolt hole 140.

[0007]

The preform 126 includes a support section 144 that is cast in the bearing section 130, and penetrated sections 146 adjacent both sides of the support section 144 to be cast in the mounting section 132 in the lower crankcase. The penetrated sections 146 include opposing surfaces 148 facing to the mounting surface 132 in the lower crankcase, and through holes 150 defining bolt holes 140. The preform 126 is formed by firing alumina fibers, and the matrix 124 of aluminum alloy is penetrated in casting to form a fiber-reinforced metal (FRM) section 152.

[0008]

In the crankshaft supporter 108, the crankshaft 106 is disposed between the bearing metals 116, 136, and is aligned by inserting a dowel 154 into the dowel holes 122, 142. By threadedly inserting coupling bolts 156 into the holes 140 and further into the bolt screw holes 120 while contacting the mounting surfaces 118, 138 each other, the lower crankcase 128 is mounted to the cylinder block 104 so as to support the crankshaft 106. An oil pan (not shown) is mounted to a bottom of the lower crankcase 128.

[0009]

The crankshaft supporter is disclosed in JP Laid-Open Nos. 2000-337348, 2001-71117, and 2002-61538.

[0010]

A crankshaft supporter disclosed in JP 2000-337348 includes a supporting structure to support a crankshaft in an internal combustion engine, and a holding section to support the support

structure, wherein the supporting structure is made of porous material, and material of the holding section flows into pores in the supporting structure.

[0011]

According to a crankshaft supporter disclosed in JP 2001-71117, a cylindrical preform having certain volume is set in a cavity in a mold, and molten metal is poured into the cavity so as to cast a cylinder block with the preform embedded therein. The preform has a part, on a side where the molten metal is poured, that is more rigid than other part.

[0012]

A crankshaft supporter disclosed in JP 2002-61538 includes: a main body of a cylinder block; a bearing below the main body; a crankshaft rotatably supported by a bearing sections that are formed in a lower part of the main body and in a bearing section; aluminum alloy layer in a sliding section of the bearing section; and a composite material around the layer having lower coefficient of thermal expansion than that of the layer in the sliding section.

[0013]

[Problems to be solved by the Invention]

In the conventional crankshaft supporter 108 shown in Figures 11 and 12, the cylinder block 104 and the lower crankcase 128 are positioned by inserting the dowel 154 into the dowel holes 122, 142 formed in the cylinder block 104 and the lower crankcase 128.

[0014]

When the lower crankcase 128 has the preform 126 cast therein with the matrix 124 of the aluminum alloy, the dowel hole 142 needs to be applied cutting process to be opened to the mounting surface 134 of the lower case after casting.

[0015]

At this time, as shown in Figure 12, not only the matrix 124 but also the FRM section 152 in the lower crankcase 128 needs to be cut after casting in case a depth "b" of the dowel, that is measured from the mounting surface 138 in the dowel hole 142 in the lower crankcase, is greater than a depth "a" of the matrix, that is measured from the mounting surface 138 of the lower crankcase to the opposing surface 148 of the penetrated section 146 in the preform 126. However, the FRM section 152 is rigid due to the matrix 124

of aluminum alloy penetrated into the preform 126 in casting.
[0016]
The dowel hole 142 is formed by cutting the FRM section 152 that is more rigid than the matrix 124 of aluminum alloy after casting process, which is hard to process and wears the blades of cutting tools.
[0017]
[Means to solve the Problems]
In order to obviate above-mentioned inconvenience, the present invention provides a crankshaft supporter having a support member which is attached to a cylinder block of an engine so as to support a crankshaft and which is formed of a matrix of aluminum alloy with a preform cast inside. The support member includes a mounting surface in contact with a mounting surface in the cylinder block, a bolt hole corresponded to a bolt hole in the cylinder block and opened to the mounting surface of the support member, and a dowel hole in coaxial alignment with the bolt hole and opened to the mounting surface of the support member. In the crankshaft supporter, a penetrated section is formed in the preform which a through hole defining the bolt hole is formed therein, and a recess section formed of the matrix to shape the dowel hole is positioned between the mounting surface of the support member and an opposing surface of the penetrated section that faces the mounting surface.
[0018]
[Mode for carrying out the Invention]
According to the present invention, due to the recess section for shaping the dowel hole made of the matrix and positioned between the mounting surface of the support member and an opposing surface of the penetrated section, cutting only the matrix of aluminum alloy permits forming of the dowel hole during the cutting process after casting, which eliminates the cutting of the FRM section that is more rigid than the matrix of aluminum alloy.
[0019]
[Embodiments]
The invention will be described with reference to Figures 1-3 which illustrate an embodiment of this invention. Figure 2 shows an engine 2 mounted on a vehicle (not shown), a cylinder block 4 cast in aluminum, a crankshaft 6 made of iron, and a crankshaft supporter

8.

[0020]

The crankshaft supporter 8 includes, in the cylinder block 4, a bearing section 10, mounting sections 12 adjacent both sides of the bearing 10, and outer walls 14 outward of the mounting sections 12.

[0021]

The bearing section 10 in the cylinder block includes a bearing metal 18 on a cylindrical semicircular bearing surface 16. The mounting sections 12 in the cylinder block have bolt screw holes 22 therein which are opened to a mounting surface 20 of the cylinder block. As shown in Figure 1, the mounting surface 12 defines therein a knock-pin (dowel) hole 24 that opens to the mounting surface 20 in coaxial alignment with the bolt hole 22. The dowel hole 24 in the cylinder block is coaxially aligned with at least one of the bolt holes 22, e.g., the left bolt hole 22 in Figure 2.

[0022]

The crankshaft supporter 8 is mounted to the cylinder block 4 of the engine 2 so as to support the crankshaft 6, and includes a lower crankcase 30 that is formed of aluminum alloy as a matrix 26 and that has a preform (core material) 28 cast (embedded) inside.

[0023]

The lower crankcase 30 includes a bearing section 32 opposing to the bearing section 10 in the cylinder block, mounting sections 34 which are located adjacent both sides of the bearing section 32 and are attached to the mounting sections 12 in the cylinder block, and outer walls 36 outward of the mounting sections 34 that correspond to the outer walls 14 in the cylinder block.

[0024]

The bearing section 32 in the lower crankcase is equipped with a bearing metal 40 on a cylindrical semicircular bearing surface 38, corresponding to the bearing metal 18 in the cylinder block. The mounting sections 34 in the lower crankcase have bolt holes 44 therein which correspond to the bolt holes 22 and which are opened to a mounting surface 42 of the lower crankcase. As shown in Figure 1, a dowel hole 46 is defined in coaxial alignment with the bolt hole 44, opening to the mounting surface 42 of the lower crankcase.

The dowel hole 46 in the lower crankcase is coaxially aligned with at least one of the bolt holes 44, e.g., the left bolt hole 44 in Figure 2.

[0025]

In this way, the lower crankcase 30 includes the mounting surface 42 in contact with the mounting surface 20 in the cylinder block 4, the bolt holes 44 which correspond to the bolt holes 22 in the cylinder block 6 and are opened to the mounting surface 42 of the lower crankcase, and the dowel hole 46 which is aligned with the bolt hole 44 and is opened to the mounting surface 42.

[0026]

As shown in Figure 3, the preform 28 has a support section 48 cast in the bearing section 32 in the lower crankcase, and a penetrated sections 50 cast in the mounting sections 34 in the lower crankcase at both sides of the support section 48. The support section 48 has a cylindrical semicircular support surface 52 adapted to the bearing section 38 of the lower crankcase. The penetrated sections 50 includes opposing surfaces 54 facing the mounting surface 42 of the lower crankcase, and through holes 56 defining the bolt holes 44.

[0027]

The preform 28 is formed by firing alumina fiber and forms a fiber-reinforced metal (FRM) section 58 by penetrating the matrix 26 of aluminum alloy thereinto during casting.

[0028]

In the crankshaft supporter 8, the lower crankcase 30 is mounted to the cylinder block 4 by positioning with a dowel 60 and by threadingly attaching coupling bolts 62 so as to support the crankshaft 6. An oil pan (not shown) is attached to a bottom of the lower crankcase 30.

[0029]

Referring to Figure 1, a recess section 64 formed of the matrix 26 to shape the dowel hole is defined between the mounting surface 42 of the lower crankcase 30 and the opposing surface 54 of the penetrated section 50 facing the mounting surface 42.

[0030]

The lower crankcase 30 includes more than one bolt holes 44. The dowel hole 46 in the lower crankcase is coaxially aligned with the

bolt hole 44, e.g. the left bolt hole 44 in Figure 2, and is opened toward the mounting surface 42 of the lower crankcase.

[0031]

In the lower crankcase 30, the recess section 64 formed of the matrix 26 to shape the dowel hole is defined between the mounting surface 42 of the lower crankcase 30, where the dowel hole 46 is formed, and the opposing surface 54 of the penetrated section 50 facing the mounting surface 42.

[0032]

Referring to Figure 3, the preform 28 includes more than one penetrated sections 50 having the through holes 56. At least one opposing surface 54 of the penetrated section 50, e.g., the left opposing surface 54 in Figure 3, is disposed at a lower position than the other opposing surface 54 by a height "c".

[0033]

That is, the preform 28 has one opposing surface 54 of the penetrated section 50 formed at a lower position along a depth of the dowel hole 46 so that the recess section 64 formed of the matrix 26 for shaping the dowel hole is defined between the mounting surface 42 of the lower crankcase, where the dowel 46 is formed, and the opposing surface 54 of the penetrated section 50 facing the mounting surface 42.

[0034]

Thereby, in the crankshaft supporter 8 shown in Figure 1, the opposing surface 54 of the penetrated section 50 of the preform 28 is displaced toward a depth of the dowel hole 44 so that a depth "e" of the matrix, measured from the mounting surface 42 to the opposing surface 54 of the penetrated section 50, becomes substantially equal to or greater than a depth "d" of the dowel, measured from the mounting surface 42 of the lower crankcase 30 to a bottom 66 of the dowel hole 44 in the lower crankcase ($d \leq e$). In this way, the recess section 64 made of matrix 26 to shape the dowel hole is formed between the mounting surface 42 and the opposing surface 54.

[0035]

The operation of the above first embodiment is described as follows.

[0036]

In the crankshaft supporter 8, the crankshaft 6 is disposed between

the bearing metals 18, 40, and is aligned its position by inserting the dowel 60 into the dowel holes 24, 46. By threadedly inserting the coupling bolts 62 into the bolt holes 44 and into the bolt holes 22 while contacting the mounting surface 20 of the cylinder block with the mounting surface 42 of the lower crankcase, the lower crankcase 30 is mounted to the cylinder block 4 to support the crankshaft 6.

[0037]

The crankshaft supporter 8 also has the lower crankcase 30 which is attached to the cylinder block 4 for supporting the crankshaft 6 and which has the preform 28 cast therein with the matrix 26 of aluminum alloy. The lower crankcase 30 has a reduced coefficient of thermal expansion by the FRM section 58 having the matrix 26 of aluminum alloy penetrated into the preform 28 made from the fired alumina fiber, which prevents expansion of oil clearance and hence reduces noise.

[0038]

Moreover, in the preform 28, the recess section 64 made of the matrix 26 to shape the dowel hole is defined between the mounting surface 42 of the lower crankcase 30 and the opposing surface 54 of the penetrated section 50 facing the mounting surface 42. After casting, the dowel hole 46 in the lower crankcase can be shaped by drilling only the matrix 26 of aluminum alloy, which eliminates drill of the FRM section 56 more rigid than the matrix 26.

[0039]

Accordingly, the crankshaft supporter 8 achieves easier cutting process of the dowel hole 46 in a short time, which extends life of the cutting tools.

[0040]

In addition, the crankshaft supporter 8 includes the dowel hole 46 in the lower crankcase which is coaxially aligned with the bolt hole 44, e.g. the left bolt hole 44 in Figure 2, and which is opened toward the mounting surface 42 in the lower crankcase. The recess section 64 made of the matrix 26 for shaping the dowel hole, is defined between the mounting surface 42 of the lower crankcase, where the dowel hole 46 is formed, and the opposing surface 54 of the penetrated section 50 facing the mounting surface 42.

[0041]

Accordingly, the recess section 64 can be formed at a part where the dowel hole 46 in the lower crankcase 30 is formed, which enhances a part where the dowel hole 46 is not formed. Casting of such preform 28 contributes to noise reduction.

[0042]

Further, the preform 28 has one opposing surface 54 of the penetrated section 50 formed at a lower position toward the depth of the dowel hole 46 so that the recess section 64 formed of the matrix 26 for shaping the dowel hole is defined between the mounting surface 42 of the lower crankcase 30, where the dowel hole 46 is formed, and the opposing surface 54 of the penetrated section 50 facing the mounting surface 42.

[0043]

Accordingly, the crankshaft supporter 8 simplifies the shape of the opposing surface 54 for the recess section 64 into a plane, which achieves easier forming of the preform 28.

[0044]

Figures 4 and 5 illustrate a second embodiment. According to the crankshaft supporter 8 of the second embodiment, the opposing surfaces 54 having the through holes 56 in the preform 28 are formed as having the same height. The preform 28 includes, in the penetrated section 50 where the dowel hole 46 is formed, a recess hole 68 to shape the dowel hole which gradually opens toward the opposing surface 54 in alignment with the through hole 56. The recess hole 68 has a depth "f" between the opposing surface 54 and a bottom 70.

[0045]

In the crankshaft supporter 8 as shown in Figure 4, the recess hole 68 is formed in the preform 28 so that a depth "e" of the matrix, measured from the mounting surface 42 to the bottom 70 of the recess hole 68, becomes substantially equal to or greater than a depth "d" of the dowel, measured from the mounting surface 42 of the lower crankcase 30 to the bottom 66 of the dowel hole 44 in the lower crankcase ($d<=e$). Thereby, the recess section 64 to shape the dowel hole, composed of the matrix 26, is formed between the mounting surface 42 of the lower crankcase 30 and the bottom 70 of the recess hole 68.

[0046]

Accordingly, the crankshaft supporter 8 of the second embodiment achieves substantially the same effect as that of the first embodiment by the recess hole 68 for shaping the dowel hole in the penetrated section 50 where the dowel hole 46 is formed, and by the recess section 64 formed of the matrix 26 between the mounting surface 42 and the bottom 70 of the recess hole 68.

[0047]

Also, the crankshaft supporter of the second embodiment includes the opposing surfaces 54 of the penetrated sections 50 of the preform 28 having the same heights, and the recess hole 68 for shaping the dowel hole in the penetrated section 50 where the dowel hole 46 in the lower crankcase is formed. Accordingly, the recess section 64 can be formed at the part where the dowel hole 46 is formed, which hardly reduces the rigid of the part where the dowel hole 46 is not formed so as to contribute to a noise reduction by casting the preform 28. Also, the recess 68 which gradually opens toward the opposing surface 54 permits smooth flow of the matrix 26 of a molten metal into the recess hole 68 in casting so as to prevent blowholes, which enhances the combination of the matrix 26 with the preform 26.

[0048]

Figures 6-8 illustrate a third embodiment. In the crankshaft supporter 8 of the third embodiment, the opposing surfaces 54 of the penetrated sections 50 which includes the through holes 56 in the preform 28, are formed at the same heights. A cylindrical protrusion 72 is formed in at least one penetrated section 50, e.g. in the left penetrated section 50 in Figure 8, and protrudes from the opposing surface 54 in alignment with the through hole 56. The protrusion 72 has a height "g" measured from the opposing surface 54 to a top end 74.

[0049]

As shown in Figure 7, the mounting section 34 in the lower crankcase 30 includes a cylindrical dowel section 76 made of the matrix 26 that protrudes from the mounting surface 42 in alignment with the bolt hole 44 and covers the protrusion 72 of the preform 28. The dowel section 76 has a height "h" measured form the mounting surface 42 to a top end 78.

[0050]

As shown in Figure 6, the mounting section 12 in the cylinder block 4 includes a dowel hole 80 in alignment with the bolt hole 22, opening to the mounting surface 20 of the cylinder block. The dowel section 76 is fitted with the dowel hole 80 in the cylinder block. The dowel hole 80 is formed so that a height "i" ranging to a bottom 82 becomes substantially equal to or greater than the height "h" of the dowel section 76 (h<=i).

[0051]

As described above, the crankshaft supporter 8 of this third embodiment has the dowel section 76 that protrudes from the mounting surface 42 and covers the protrusion 72 of the preform cast in the lower crankcase 30. Thereby, after casting, the dowel section 76 can be formed only by cutting the matrix 26 of aluminum alloy covering the protrusion 72 to be inserted into the dowel hole 80 in the cylinder block 4. This can avoid the cutting or drill process to the FRM section 58 more rigid than the matrix 26 of aluminum alloy and achieves easier forming of the dowel section 76 to extend life of the blades of the cutting tools.

[0052]

Also, the crankshaft supporter 8 of the third embodiment includes the opposing surfaces 54 formed at the same height, and the protruded dowel section 76 in one penetrated section 50. Accordingly, the penetrated sections 50 can have the substantially same rigidity, which contributes to the noise reduction by the cast preform 28. Moreover, the dowel section 76 of the preform 28 cast into the lower crankcase 30, protrudes from the mounting surface 42, so that separate dowel can be eliminated to mount the lower crankcase 30 to the cylinder block 4, which reduces the number of parts and number of assembly process.

[0053]

Figures 9 and 10 illustrate a fourth embodiment. As shown in Figure 10, in the crankshaft supporter 8 of the fourth embodiment, the opposing surfaces 54 of the preform 28 are formed at the same height, and a member 84 for the dowel protrudes from the opposing surface 54 in coaxial with the through hole 56 in the left protruded section 50. In the mounting section 34 in the lower crankcase 30, a cylindrical dowel section 86 is formed of the matrix 26, which is in coaxial with the bolt hole 44 and covers the member 84 for the

dowel. As shown in Figure 9, a dowel hole 88 is defined in the mounting section 12 in the cylinder block 4 and opens to the mounting surface 20 in coaxially alignment with the bolt hole 22, which the dowel section 86 is fitted. A tapered section 90 is provided at an end of the member 84 for easier insertion to the preform 28.

[0054]

As thus described, the crankshaft supporter 8 of this fourth embodiment includes the dowel section 86 that protrudes from the mounting section 42 to cover the member 84 for the dowel of the preform 28 cast into the lower crankcase 30. The dowel section 86 that is fitted into a dowel hole 94 in the cylinder block 4 can be formed only by cutting the matrix 26 of aluminum alloy covering the member 84 after casting. This eliminates the cutting of the FRM section 58 that is more rigid than the matrix 26 of aluminum alloy, which achieves easier forming process to the dowel section 86 in a short time and extends the blades of the cutting tool.

[0055]

Also, the crankshaft supporter 8 of the fourth embodiment includes the opposing surfaces 54 formed at the same height, and the member 84 for the dowel inserted into one penetrated section 50. Accordingly, the penetrated sections 50 can have the substantially same rigidity, which contributes to the noise reduction by the cast preform 28. Also, the dowel section 86 in which the member 84 is cast in the lower crankcase 30, protrudes from the mounting surface 42 to eliminate the assembly process for fitting the dowel into the lower crankcase 30.

[0056]

[Effects of the Invention]

As thus described, cutting only the matrix of aluminum alloy permits forming of the dowel hole during the cutting process after casting, which eliminates the cutting of the FRM section that is more rigid than the matrix of aluminum alloy.

[0057]

The crankshaft supporter therefor achieves easier forming process to the dowel hole in a short time and extends the blades of the cutting tools.

[Brief Description of the Drawings]

Figure 1 is an enlarged cross-sectional view of a crankshaft supporter according to a first embodiment as indicated by an arrow "I" in Figure 2.

Figure 2 is a cross-sectional view showing the crankshaft and surroundings of an engine of the first embodiment.

Figure 3 is a cross-sectional view of a preform of the first embodiment.

Figure 4 is an enlarged cross-sectional view of the crankshaft supporter according to a second embodiment.

Figure 5 is a cross-sectional view of the preform of the second embodiment.

Figure 6 is an enlarged cross-sectional view of the crankshaft supporter according to a third embodiment.

Figure 7 is a cross-sectional view of a lower crankcase of the third embodiment.

Figure 8 is a cross-sectional view of the preform of the third embodiment.

Figure 9 is an enlarged cross-sectional view of the crankshaft supporter according to a fourth embodiment.

Figure 10 is a cross-sectional view of the lower crankcase of the fourth embodiment.

Figure 11 is a cross-sectional view showing the crankshaft and surroundings of an engine of a prior art.

Figure 12 is an enlarged cross-sectional view showing a part indicated by an arrow "XII" in Figure 11 of the prior art.

[Explanation of Reference Numerals]

2 engine; 4 cylinder block; 6 crankshaft; 8 crankshaft supporter; 10 bearing section in the cylinder block; 12 mounting section in the cylinder block; 20 mounting surface in the cylinder block; 22 bolt screw hole; 24 dowel insert hole in the cylinder block; 26 matrix; 28 preform; 30 lower crankcase; 32 bearing section in the lower crankcase; 34 mounting section in the lower crankcase; 42 mounting surface in the lower crankcase; 44 bolt insert hole; 46 dowel insert hole in the lower crankcase; 48 support section; 50 protruded section; 54 opposing surface; 56 through hole; 58 FRM section; 60 dowel; 62 coupling bolt; and 64 recess section.

[Abstract]
[Purpose] The purpose of this invention is to provide easier shaping of a dowel hole to extend life of cutting tools.
[Constitution] The present invention provides a crankshaft supporter having a support member which is attached to a cylinder block of an engine so as to support a crankshaft and which is formed of a matrix of aluminum alloy with a preform cast inside. The support member includes a mounting surface of the support member, bolt holes, and a dowel hole. A penetrated section having a through hole defining the bolt hole is formed in the preform. A recess section is formed of the matrix, and is positioned between the mounting surface of the support member and an opposing surface of the penetrated section that faces the mounting surface so as to shape the dowel hole.

FIG. 1

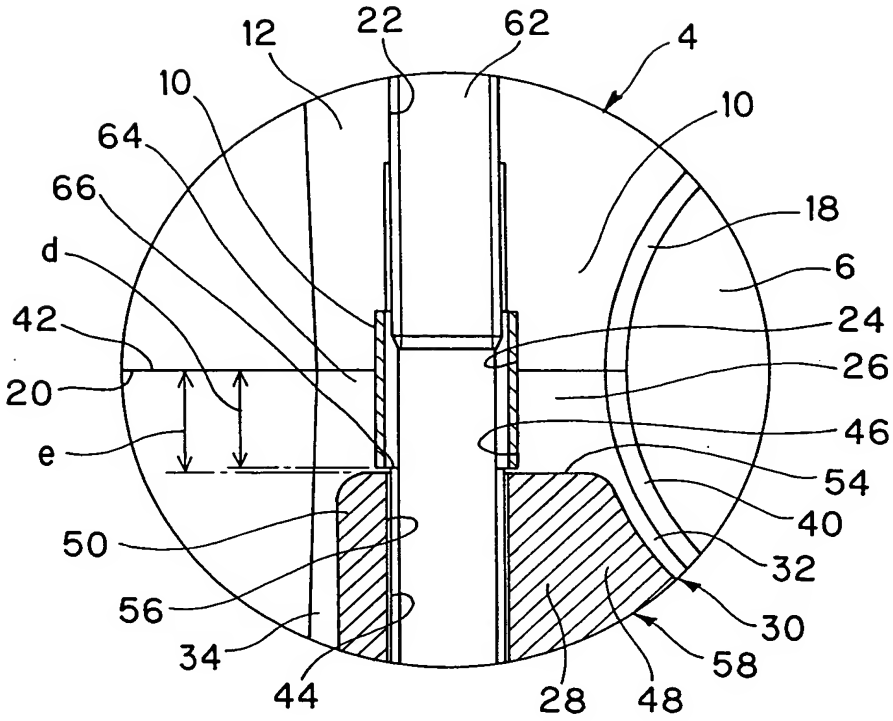

FIG. 2

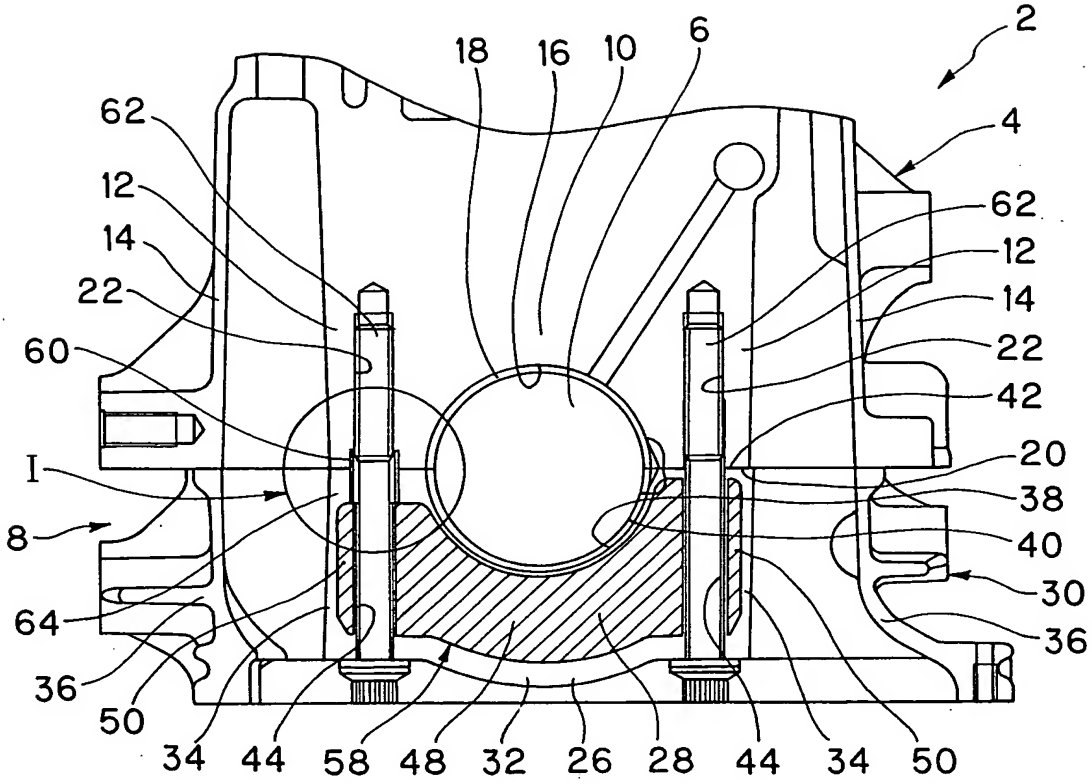
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FIG. 3

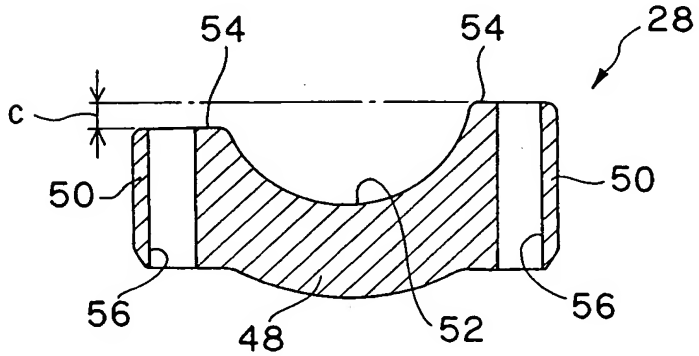
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FIG. 4

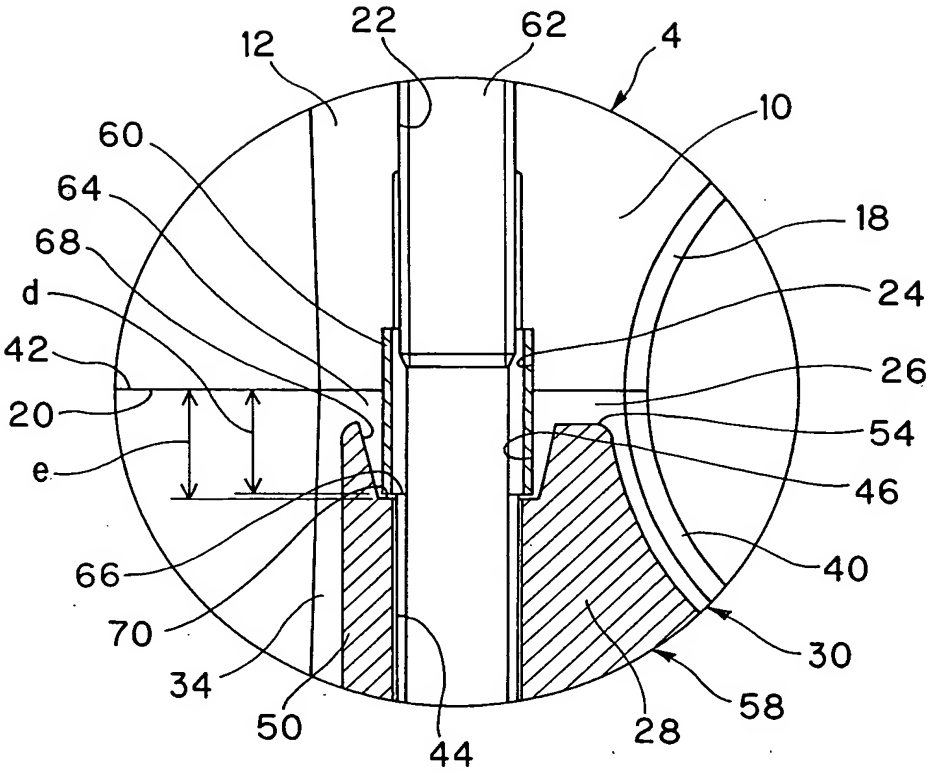
12
22
62
4
10
60
64
68
d
42
20
e
18
24
26
54
46
40
30
58
28
44
50
34
70
66

FIG. 5

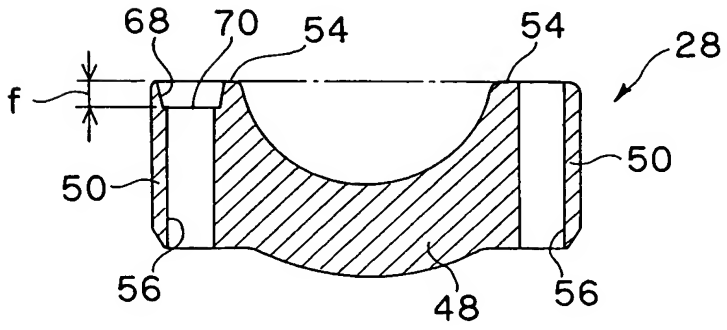
68
70
54
54
28
f
50
50
56
48
56

FIG. 6

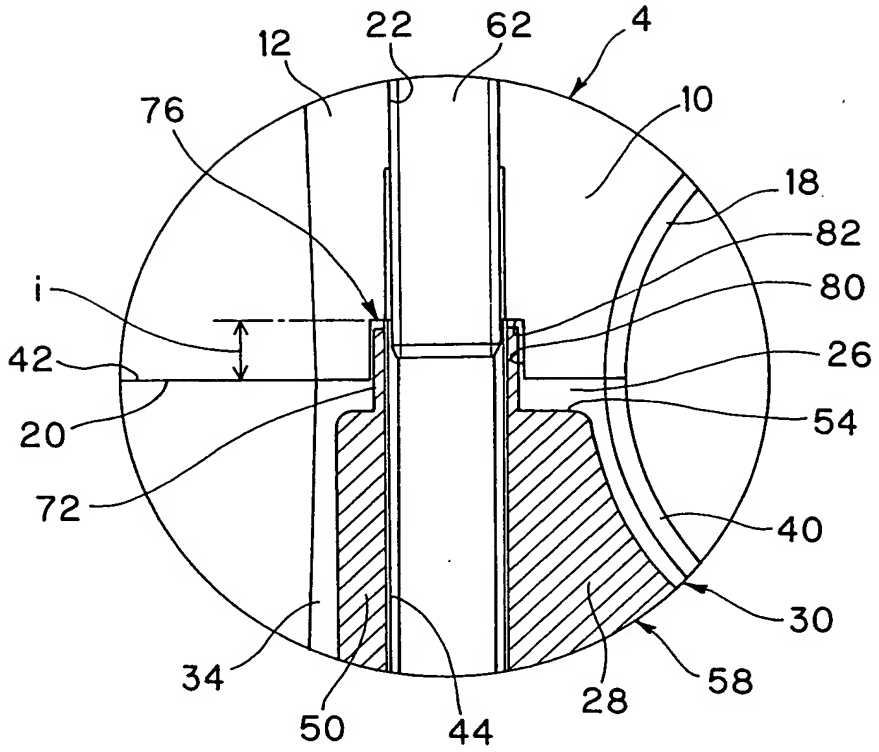

FIG. 7

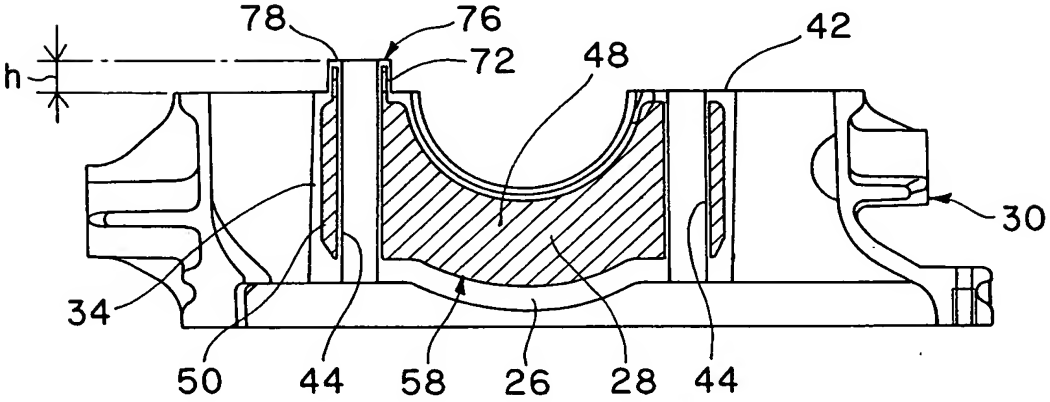

FIG. 8

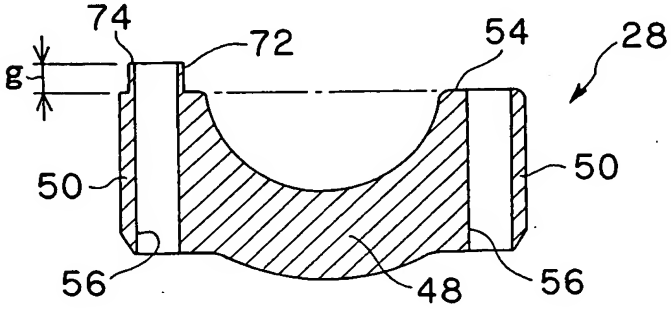

FIG. 9

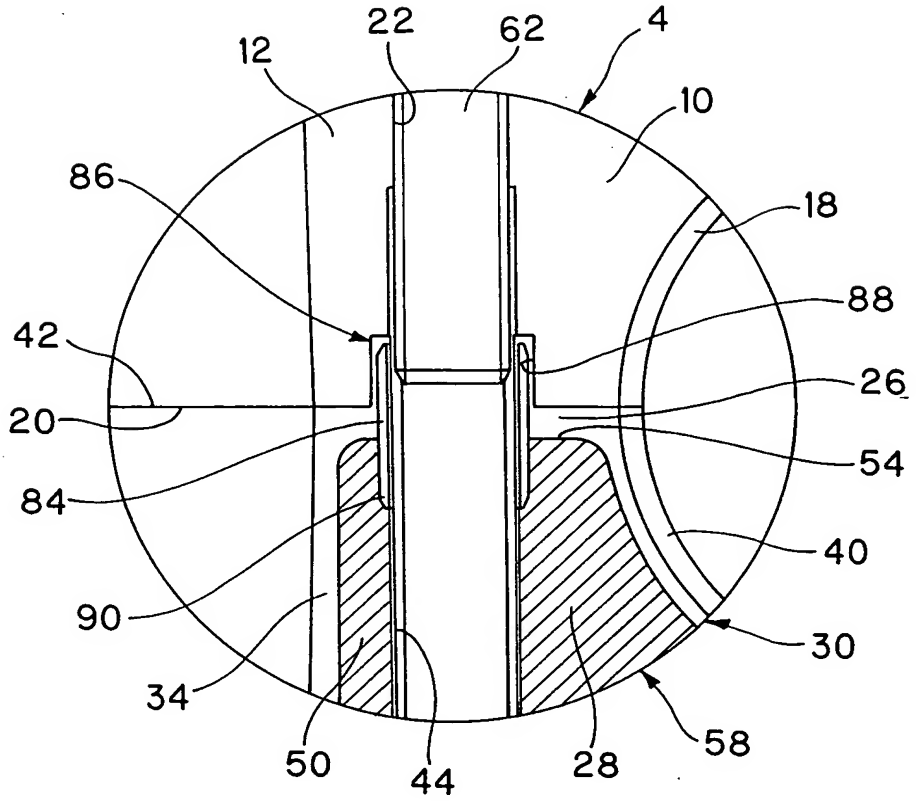
22
62
4
12
10
86
18
88
42
26
20
54
84
40
90
30
34
58
50
44
28

FIG. 10

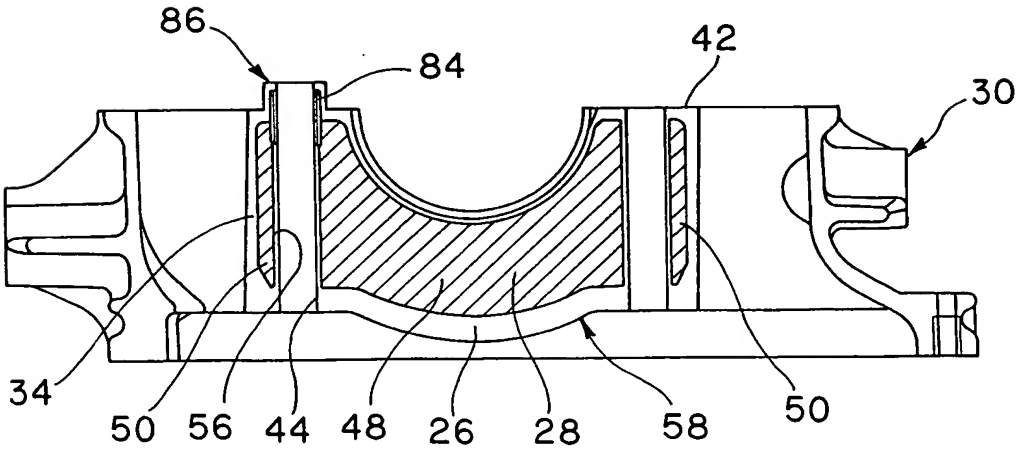
86
84
42
30
34
50
56
44
48
26
28
58
50

FIG.11

PRIOR ART

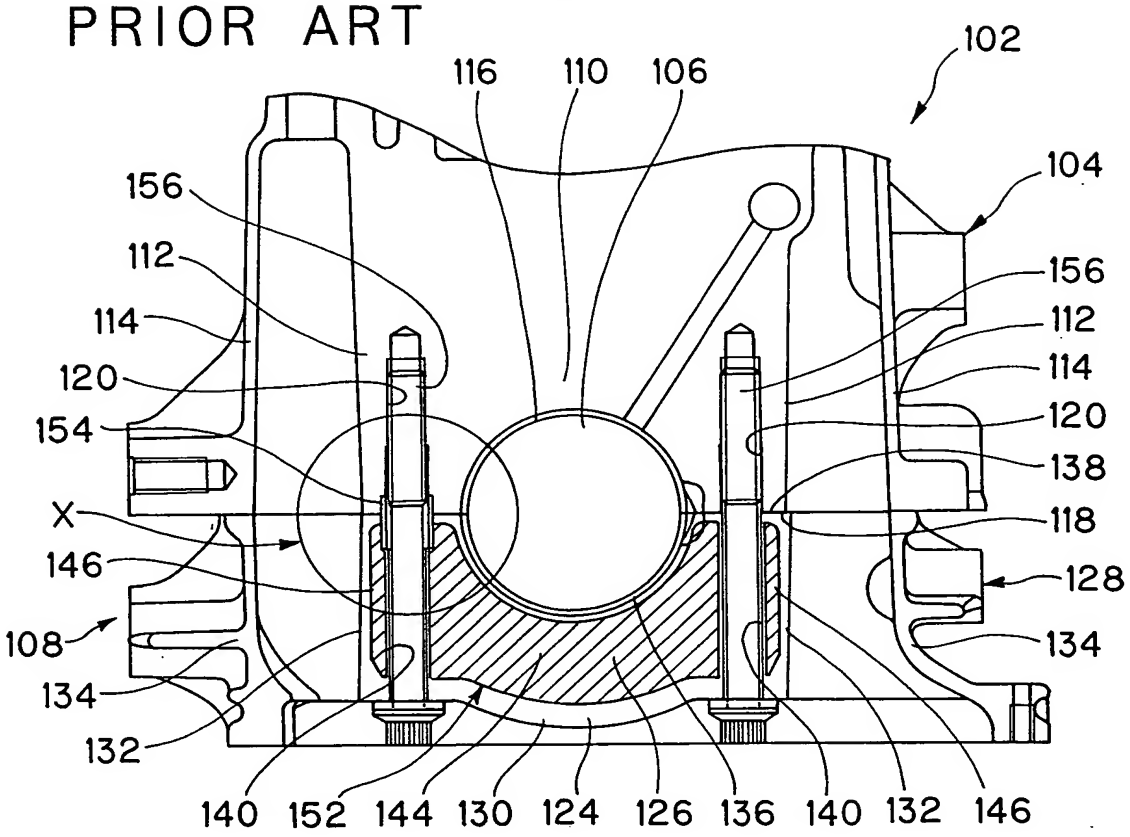

FIG.12

PRIOR ART